Title: METHOD FOR CALIBRATING AN IMAGE-SCANNING MODULE

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Cross-Reference to Related Applications

[0001] This application claims priority to Taiwan Patent Application Serial No. 092108263 filed on April 10, 2003.

Field of Invention

[0002] The present invention relates to a method for calibrating an image-scanning module. More specifically, it relates to a method for calibrating an image-scanning module by scanning a reference sheet.

Background of the Invention

[0003] An image-scanning module is the most critical component in a scanner. As shown in Fig. 1a, before being assembled into the scanner **100**, the image-scanning module **110** needs to undergo various tests and calibrations. For example, the position of the lens may be adjusted to meet a requirement, or the positions of the photo sensors are adjusted to receive the optical signals from the lens more accurately and more efficiently.

[0004] Fig. 1b and Fig. 1c are schematic diagrams illustrating a prior art method of calibrating the image-scanning module. The reference sheet **200** has a target label **210** thereon. First, a reference sheet **200** is confined by a confining device **500** to a specific position on the image-scanning module **110**. The image-scanning module **110** scans the reference sheet **200** to obtain a corresponding image. Then the image-scanning module is adjusted according to the image information of the target label **210**. However, in practice, the relative position of the reference sheet **200** and the image-scanning module **500** varies each time, even with the help of the confining device **500**, and thus the calibrations are

imperfect. Besides, the magnifying effect caused by the lens would further degrade the calibration.

Summary of the Invention

[0005] It is an aspect of the present invention to calibrate an image-scanning module.

[0006] It is another aspect of the present invention to calibrate an image-scanning module scanning a reference sheet to produce an image.

[0007] It is still another aspect of the present invention to compensate the variations during the process when an image-scanning module scans a reference sheet to produce an image.

[0008] A method for calibrating an image-scanning module scanning a reference sheet to produce an image is provided. The image-scanning module has a first midpoint, which corresponds to a first midpoint coordinate value on the image, and the reference sheet has a target label. A first label corresponds to a first end of the reference sheet, and a second label corresponds to a second end of the reference sheet. The distance between the first label and the second label is measured as a first value. The calibration is carried out by comparing the actual positions of the first midpoint, the target label, the first label, and the second label with their corresponding coordinate values on the image obtained from scanning the reference sheet.

[0009] The presented method includes (a) scanning the reference sheet to obtain a target coordinate value corresponding to the target label, a first coordinate value corresponding to the first label and a second coordinate value corresponding to the second label; (b) obtaining a second midpoint coordinate value according to the first coordinate value and the second coordinate value; (c) calculating a shift value as being the difference between the second midpoint coordinate value and the first midpoint coordinate value; (d) calculating a second value as being the difference between the first coordinate value and the second coordinate

value; (e) calculating a magnification as being the ratio of the second value to the first value; and (f) adjusting the target coordinate value to obtain a calibrated target coordinate value according to the shift value and the magnification.

Brief Description of the Drawings

[0010] Fig. 1a is a schematic diagram of a scanner according to a prior art.

[0011] Fig. 1b is a schematic diagram illustrating a prior art method of calibrating the image-scanning module.

[0012] Fig. 1c is a schematic diagram of prior art apparatus for calibrating the image-scanning module.

[0013] Fig. 2 shows an image-scanning module and a reference sheet according to an embodiment of the presented invention.

[0014] Fig. 3 is a flow chart according to an embodiment of the presented invention.

Detailed Description

[0015] This invention presents a method for calibrating an image-scanning module. According to an embodiment, Fig. 2 shows an image-scanning module **110** and a reference sheet **200**. The image-scanning module **110**, providing the scanning capability of a scanner, includes lens and photo sensing devices such as a charged coupled device or a contact image sensor. However, a variety of reasons would degrade the uniformity of the scanned image, and the magnifying effect caused by the lens would multiply the variations. Therefore the calibration of the image-scanning module **110** includes the adjustments of the positions of the lens and photo sensing devices, or of other optical elements. Moreover, the adjustments of the sizes of elements in the image-scanning module **110** are also included.

And as the method presents, the image-scanning module **110** is calibrated according to the information obtained from scanning the reference sheet **200**.

[0016] As shown in Fig. 2, the image-scanning module **110** has a first midpoint **111**. In an embodiment, it is the scanning area that defines the first midpoint **111**. In another embodiment, the first midpoint **111** is the geometric midpoint of the image-scanning module **110**. It should be noted that the first midpoint **111**, whose position is substantially fixed, corresponds to a first midpoint coordinate value CM1 on the scanned image, and thus the value CM1 is fixed too.

[0017] The reference sheet **200** includes a target label **210**, a first label **230** corresponding to the first end of the reference sheet **200**, and a second label **250** corresponding to the second end of the reference sheet **200**. It should be noted that a plurality of target labels on the reference sheets **200** is also allowable. The distance between the first label **230** and the second label **250** is measured as **D1**. In an embodiment, the target label **210** is a gray-scale patch; the first label **230** and the second label **250** are black segments. In another embodiment, the target label **210**, the first label **230**, and the second label **250** could be other kinds of marks such as red spots or blue patches.

[0018] Fig. 3 is a flow chart according to an embodiment of the invention. It begins with the step **301**: scanning the reference sheet **200** to obtain an image; on the image being a target coordinate value CT corresponding to the target label **210**, a first coordinate value C1 corresponding to the first label **230** and a second coordinate value C2 corresponding to the second label **250**.

[0019] It proceeds with the step **303**: obtaining a second midpoint coordinate value CM2 according to the first coordinate value C1 and the second coordinate value C2. In an embodiment, CM2 is obtained from the average of C1 and C2. Then it turns to the step **305**:

calculating a shift value S as being the difference between the second midpoint coordinate value CM2 and the first midpoint coordinate value CM1.

[0020] Then it moves to the step **307**: calculating a second value D2 as being the difference between the first coordinate value C1 and the second coordinate value C2. After that, it goes to the step **309**: calculating a magnification M as being the ratio of the second value D2 to the first value D1. The magnification M relates to the magnification ratio of the lens.

[0021] Next is the step **311**: adjusting the target coordinate value CT to obtain a calibrated target coordinate value CTPRIME according to the shift value S and the magnification M. The calibration process completes with the step **313**: setting the target label **210** to correspond to the calibrated target coordinate value CTPRIME.

[0022] In an embodiment, the step **311** is construed as adding the shift value S to the target coordinate value CT to obtain the calibrated target coordinate value CTPRIME. This can correct the position variations of the elements in the image-scanning module.

[0023] In another embodiment, the step **311** includes normalizing the target coordinate value CT according to the magnificence M to obtain the calibrated target coordinate value CTPRIME. Thus the variation-magnifying effect caused by the lens can be compensated.

[0024] In accordance with another embodiment, the step **311** includes adding the shift value S to the target coordinate value CT and then normalizing the target coordinate value CT according to magnificence M to obtain the calibrated target coordinate value CTPRIME.

[0025] While this invention has been described with reference to the illustrative embodiments, these descriptions should not be construed in a limiting sense. Various modifications of the illustrative embodiment, as well as other embodiments of the invention, will be apparent upon reference to these descriptions. It is therefore contemplated that the appended claims will cover any such modifications or embodiments as falling within the true scope of the invention and its legal equivalents.